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APPENDIX to
COCOM Document No.3712.NI 1/3
(previously issued as
Electrical and Power Generating
Equipment New Item No.1/W.P.2)

MEMORANDUM SUBMITTED BY THE UNITED STATES DELEGATION

ON THE 23rd NOVEMBER, 1959

Electrical and Power-Generating Equipment
New Item No. I - Electron Beam Welders

In W.P. I in this category the United States proposed that the following new item be placed on IL International List I :

"Electron beam welders and specially designed components."

There is set forth below a further description of such equipment which may be useful to Delegates and Governments :

"The technique of electron beam welding makes use of the high energy available in a focused beam of electrons to melt and fuse together pieces of metal to be joined. The resultant joints are clean and have high penetration and, in addition, require little power to produce since the heating effect of the beam is highly localized. For this reason too, distortion is generally negligible.

A high vacuum is necessary for the stability of the electron beam, which is produced by accelerating electrons drawn from a heated filament through a high voltage gradient. The natural tendency of the beam to diverge is counteracted by a magnetic focusing field. The work itself is placed on a table in the vacuum chamber and moved by actuating it through seals in the chamber wall while the beam is directed against it.

The following is a brief description of a specific electron beam welder. The equipment consists of a vacuum chamber with necessary sight and access parts, a work fixture with powered rotational or longitudinal motion and manual lateral adjustment, an electron gun with focusing attachment, a pumping system, a high voltage power supply, and necessary auxiliary power supplies and controls.

The welder is supplied in three units, the welding chamber and pumping system, the high voltage power supply, and an electrical console, in separate enclosures, which can be arranged to suit the operator and place all controls within easy reach. Only single electrical and water connections are required to put the welder into operation. The standard unit has a high voltage power supply with 10 KV accelerating voltage, 0-100 milliamperes, 1 KW. An optional power supply is available with 20 KV accelerating voltage, 0-100 milliamperes, 2 KW.

The vacuum chamber is 24" diameter and 21" deep with side and bottom parts. The standard unit provides a maximum longitudinal weld of 4" and circular weld of 8". Optional equipment is available for end weldments or long tubes and for long seam welds.

The main vacuum pumping system consists of one 6-inch high vacuum oil diffusion pump, with speed of approximately 1500 CFM at .0001mm Hg. and blank off less than .000001 mm Hg ; one rotary gas ballast mechanical pump, with 30 CFM capacity ; and 6" high vacuum and manifold valve. The electron beam gun pumping system consists of a 2-inch oil diffusion pump, with speed of approximately 150 CFM in the range of .001 to .0001 mm of Hg. and blank off at less than .000001 mm. Hg. ; and a high vacuum slide value.

The electrical control console contains the necessary controls and equipment for starting, stopping and operating the welder. These consist of main disconnect switch, starter for mechanical pump and contractors for diffusion pumps, filament power supply, beam focusing coil power supply, stepdown transformers, and interlocks to prevent operation of gun unless chamber is under vacuum.

The electron beam gun and gun tube assembly is mounted on the vacuum chamber. It has replaceable filaments, proper insulation, and cover for protection of operator. A beam focusing coil is mounted within the gun-tube assembly.

While the components of the welder, their size and arrangement, design and construction will vary, depending upon the manufacturer and size capacity and metals to be melted, electron beam welders in general will consist of the basic components enumerated above.

The electron beam welder is a recent development and its uses have not been fully evaluated. It has been used to weld such metals as molybdenum, aluminum, tungsten, tantalum, beryllium, hafnium, zirconium, columbium, and yttrium. It is expected that it will find application in welding the refractory metals and high temperature alloys used in nuclear, electronic, and missile hardware.